URETHRAL MOBILIZATION AND ADVANCEMENT FOR DISTAL HYPOSPADIAS

Dissertation submitted for

M.Ch. Degree Examination
Paediatric Surgery
Branch V
August 2007.

Institute of Child Health & Hospital for Children,
Madras Medical college & Research Institute,

The Tamil Nadu Dr. MGR Medical University,
Chennai.

CERTIFICATE

Certified that the dissertation entitled "***Urethral Mobilization and Advancement for Distal Hypospadias***" is the original work undertaken by **Dr. K.Ravi** under our guidance and supervision, in the Department of Paediatric Surgery, Institute of Child Health and Hospital for Children, Madras Medical College and Research institute, Chennai-3., during the period of his post graduation in M.Ch Paediatric Surgery from 2004-2007, in partial fulfillment of the university rules and regulations for the award of M.Ch degree.

Professor and Head of Department,
Department of Paediatric Surgery,
ICH & HC,
Chennai.

Director& Superintendent,
Institute of Child Health &
Hospital for Children,
Chennai.

The Dean,
Madras Medical College & Research Institute,
Chennai.

DECLARATION

I declare that this dissertation entitled "***urethral mobilization and advancement for distal hypospadias"*** has been conducted by me at the Institute of Child Health and Hospital for Children. It is submitted in part of fulfillment of the award of the degree of M.Ch (Pediatric Surgery) for the August 2007 examination to be held under the Tamil Nadu Dr. M.G.R Medical University, Chennai. This has not been submitted previously by me for the award of any degree or diploma from any other university.

Dr. K.RAVI

ACKNOWLEDGEMENTS

I sincerely thank our Director Prof. **R. Kulandhai Kasthuri** M.D., D.C.H., for having permitted me to carry out this work in this institution.

I am greatly indebted to Prof. **P.Jeyakumar** M.Ch., Head of the Department, Dept. of Paediatric Surgery, ICH & HC, for his invaluable help, guidance, encouragement and constant support throughout the study with his vast experience and knowledge.

A special word of thanks to Prof. **Philip Chandran** M.Ch., Prof. **S.V.Senthilnathan** M.Ch., for their guidance during working on this dissertation.

I express my sincere gratitude to Prof**. K.Seeniraj** M.Ch., for his expert guidance and motivation for me to complete this work.

I am thankful to Prof**. Rajkishore Bagdi** M.Ch., Prof**. G.Ilango** M.Ch., and Prof**. R.Baskar** M.Ch., for their advice.

I express my sincere thanks to all our **Assistant Professors** for their kind support and constant encouragement during the period of this study.

I would like to thank all the children and their parents for their consent and participation.

TABLE OF CONTENTS

HISTORICAL PERSPECTIVE

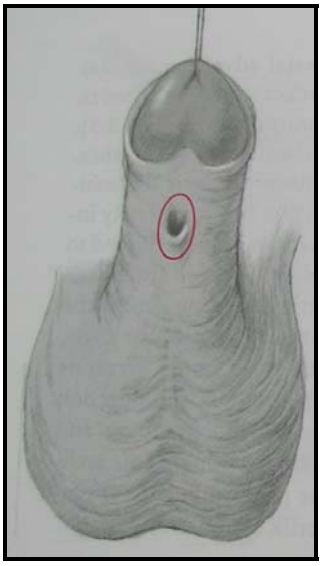
The term hypospadias is derived from the Greek word "**hypo**" means under and "**spadon**" means a rent or fissure (**Duckett** and **Baskin** 1996; **Zaont** and **Packer** 1997).

Many modern surgeons mention the originality of their ideas, but an investigation of historical papers, documents and books indicates that all current techniques, theoretical and practical knowledge were described centuries ago by various surgeons.

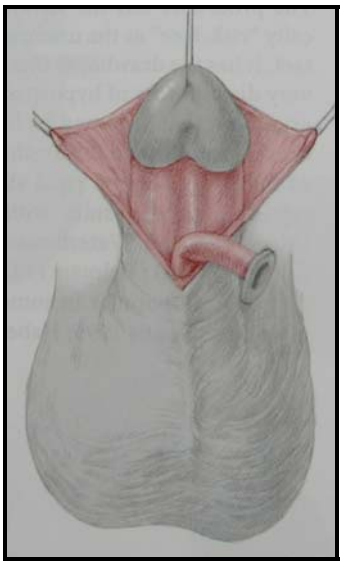
The first attempt to make the meatus in a terminal position was by **Helidorus** and **Antyllus** in Alexandria, Egypt in the first century AD. They simply amputated the penile tissue distal to the existing meatus in distal forms of hypospadias.

Beck (1898) and **Hacker** (1898) presented a special technique for the distal type of hypospadias without chordee (Fig.1). They undermined and mobilized the urethra and advanced it into the glans. Tunnelisation of the glans was performed with help of a trochar like instrument. For deeper grooves they advised cutting the glans medially and reapproximating it over the advanced urethra.

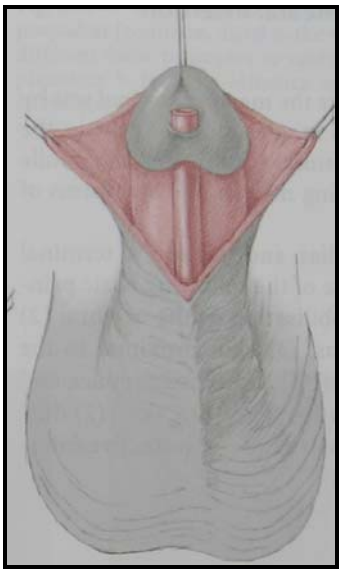
Fig.1. Urethral Mobilization (Beck and Hacker)



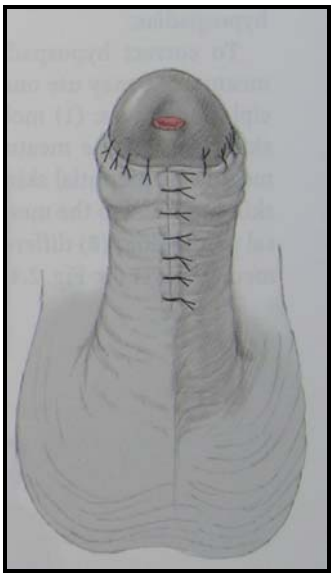
a. Incision around meatus



b. Urethral Mobilization



c. Glans Tunneling



d. Preputioplasty

In 1981, **Duckett** presented a meatal advancement and glanuloplasty (**MAGPI**) technique for subcoronal and glanular cases without chordee (**Duckett** 1981). In 1982, **Baran** used a modification of the Beck and Hacker technique by elongating the distal urethra to the tip of the penis through a surgically created tunnel (**Baran** and **Cenetoglu** 1993). A glanular triangular flap was used in the meatal anastomosis in order prevent stricture formation. This was an operation especially advised for circumcised hypospadias patients.

Any technique to repair distal hypospadias should be simple, easy and result in satisfactory functional and cosmetic outcomes, with few complications. Many techniques have been described which relocate the urethral meatus and correct chordee.

Ti Chang Shing described a technique in 1984, for the treatment of distal hypospadias that meets these criteria with its unique character of avoiding anastomosis. This technique is associated with certain problems including difficulty for urethral dissection and postoperative meatal stenosis. Distal hypospadias represents the most common variant of hypospadias that the pediatric urologist treats. Anterior urethral advancement is a technique for repair of distal penile hypospadias and urethral fistula by a one stage operation that can be used in circumcised and non circumcised patients.

INTRODUCTION

Hypospadias is one of the most common congenital anomalies occurring in approximately 1:250 to 1:300 live births. In patients with severe hypospadias the genitalia may look ambiguous at birth resulting in emotional and psychological stress for parents in that the gender assignment of their baby immediately comes into question. If left uncorrected patients with hypospadias may need to sit down to void and tend to shun intimate relationships because of the fears related to normal sexuality.

The general principles of hypospadias surgery combine correction of penile curvature with reconstruction of the missing urethra to provide a functional as well as cosmetically acceptable terminal urethral meatus. Many one and two stage procedures have been described to achieve this objective, which reflects the wide spectrum of this common congenital anomaly and the failure of any single technique to win uniform acceptance. In dealing a boy with hypospadias, the surgeon has to correct the following major abnormalities.

1. Abnormal ventral curvature or chordee, by orthoplasty.
2. Abnormal proximal meatal insertion, by urethroplasty.
3. Abnormal looking glans penis, by glanuloplasty and meatoplasty.
4. Abnormal looking prepuce, either by circumcision or prepuce reconstruction.

Abnormal ventral curvature of penis and orthoplasty:

Gittes and **Mc Laughhlin**, writing in 1974, described intraoperative saline inflation of the corpora cavernosa. This guided and ensured successful orthoplasty. This artificial erection test has been refined with normal saline and transglanular needle placement.

There are two types of chordee associated with hypospadias. The first is the chordee that is occasionally present in patients with distal hypospadias (skin chordee). This superficial chordee is subcutaneous, proximal to the meatus and can be corrected by mobilization of the skin proximal to the meatus (**King** 1970, 1981).

The other type of chordee is commonly associated with proximal type hypospadias. It is usually deep, fibrous and located distal to the meatus. There are three basic techniques to correct this type of deep fibrous chordee.

a. The abnormal ventral curvature can be corrected by dorsal plication, first described by **Physick** (**Pancoast** 1844) and popularized as the **Nesbit procedure** (1965), but this has the disadvantage of shortening the penis.
b. More commonly, the chordee can be corrected by excision of the ventral subcutaneous fibrous bands, usually proximal to the meatus in distal hypospadias (skin chordee). In proximal forms, the contractions are usually distal to the meatus and a transverse incision and excision of fibrous bands

can be carried out as first described by **Pancoast** (1844) and commonly called **Heineke-Mikulicz technique**.

c. Another way of correcting chordee is by corporal rotation, first described by **Koff** and **Eakim** (1984). **Decter** (1999) added midline ventral splitting and called it the "**split and roll**" technique. Various skin and fascial grafts and flaps have been used to cover the resultant defect in multistage repair.

Abnormal proximal meatal insertion and urethroplasty:

To correct hypospadias and achieve a terminal meatus, one may use one of the following techniques:

1. Mobilization of the urethra
2. Urethroplasty using skin distal to the meatus
3. Urethroplasty by meatal based flaps
4. Urethroplasty using preputial skin
5. Urethroplasty using prepuce and skin proximal to meatus
6. Urethroplasty using scrotal skin
7. Urethroplasty using dorsal penile skin
8. Urethroplasty using different grafts

Urethral mobilization:

Urethral mobilization and meatal advancement was first described by **Beck** and **Hacker** in 1898 (quoted in **Horton** 1973) for balanic hypospadias. The idea is to make use of the elasticity of the urethra. This procedure has the advantage that it is theoretically "risk free" as the urethra remains completely intact.

It has the drawback that it can only be applied to distal forms of hypospadias. There is always the argument that you may be bringing the glans to the urethra rather than the urethra to the tip of the glans, as the penis is not a rigid structure. Some surgeons reported good results with urethral mobilization (**Mc Gowan** and **Waterhouse** 1964; **Waterhouse** and **Glassberg** 1981; **Belman** 1977; **Koff** 1981). This technique is popular in some parts of Europe (**Keramidas** and **Soutis** 1995; **Haberlik et al**. 1997).

Duckett (1981) described the "meatal advancement and glanuloplasty incorporated" (**MAGPI**) procedure, which combines the use of the Heineke-Mikulicz technique with urethral mobilization in glanular hypospadias utilizing the elasticity of the urethra. **Arap** and his colleagues, in 1984, modified the MAGPI procedure by placing two sutures on the ventral skin edge and forming an "M" configuration. **Harrison** and **Grobbelaar** (1997) described the urethral advancement and glanuloplasty procedure, which modifies MAGPI by having a V-shaped incision around the original meatus before mobilization and having

deep glanular wings. The meatus is advanced to the tip of the glans and two deep glanular wings are rotated upwards and wrapped around the urethra.

Glanuloplasty and meatoplasty:

There are several techniques employed to achieve an apical meatus

a. **Russell** (1900) described glans channel technique to deliver the urethra to the apex of the glans. **Bevan** (1917), **Davis** (1940), **Ricketson** (1958), **Duckett** (1980) and **Hendren** (1981) used same principle but different flaps or grafts.
b. Glans wing rotation is used in most recent techniques.
c. **Devine** and **Hortan** (1961) and **Mustarde** (1965) popularized the glans channel procedure and included a dorsal V- flap with the glans channel.
d. The glans split has been used in various techniques to move the meatus to the apex (**Beck** 1917; **Humby** 1941; **Barcat** 1973; **Mays** 1951; **Cronin** and **Guthrie** 1973; **Turner-Warwick** 1979).
e. **Duckett**, in 1981, described the "meatal advancement and glanuloplasty incorporated" (MAGPI) procedure. **Arap et al**. (1984) modified the MAGPI technique by using two sutures instead of one. **Decter,** in 1991, described an "M inverted V" technique.
f. **Rich et al**. (1989) described incising the urethral plate in the midline (hinging). This helped to achieve a slit like vertical meatus.

g. **Snodgrass** (1994) extended the concept of urethral plate hinging by incising the whole urethral plate in the midline from the hypospadiac meatus distally. This helps in tubularisation of the plate.

Most of the described surgical procedures for reconstruction of the neourethra utilize non urethral tissue such as penile or prepucial skin grafts, and buccal or bladder mucosa. An alternative to creating a neourethra is mobilization and elongation of the existing urethra and advancement of its meatus to a distal position. This principle could be used in hypospadias repair to bridge part of or the entire urethral defect.

Urethral advancement was first described by **Beck** and latter popularized by **Waterhouse** and **Glassberg**, **Koff** and **Barran**. Proponents of urethral mobilization recommend its use mainly in the management of distal penile hypospadias. Recent reports incorporated the technique with preservation and tubularisation of the urethral plate in the management of more proximal hypospadias. This urethral mobilization and advancement technique is not widely used, probably

1. Due to the early unsuccessful attempts of limited urethral mobilization and the subsequent development of chordee secondary to a taut urethra.
2. Due to fear of ischemia from extensive dissection of urethra.
3. Potential for its injury during urethral dissection.

Glanular, coronal and subcoronal hypospadias are milder forms of distal hypospadias, rarely associated with true fibrous chordee. Deviation of the urinary stream is usually the only functional problem and because of that not all the patients were treated surgically in the past. However the abnormally situated urethral meatus and unsightly appearance of the prepuce may cause psychological stress.

Following publication of the Mathieu procedure in the year 1932, several techniques have been employed for the treatment of distal hypospadias using either the ventral penile skin (**Gonzales et al**. 1983) or tubularised skin flaps (**Mustarde** 1965; **Kim** and **Hendren** 1981; **King** 1981). Fistulae and meatal stenosis have been reported as postoperative complications. A new procedure for subcoronal hypospadias known as MAGPI (meatal advancement, glanuloplasty and preputioplasty incorporated) was described by **Duckett** in 1981. The MAGPI procedure is a simple operation yields a cosmetically acceptable penis and has a minimal complication rate (**Hensle et al**. 1983; **Man et al**. 1984; **Linve et al**.1984; **Duckett** and **Snyder** 1991). However, it is not generally applicable to all forms of distal hypospadias. Severe ventral tilt of the glans, especially in cases with preoperative ventriflexion, has been reported (**Gibbon** and **Gonzales** 1983; **Mitchell** 1993; **Arab et al**. 1984; **Nasrallah** and **Minnot** 1984; **Paulus et al**. 1993). As an alternative, modification of either the Mathieu (**de Jong** K J and

Boemers 1993) or the Barcat (**Koff et al**. 1994) techniques were used. With these techniques the prepuce is not retained, and with Barcat procedure meatal stenosis, diverticulum or sebaceous cyst formation and urinary infection can occasionally occur. In order to overcome these problems, a procedure which incorporates urethral mobilization and advancement, glanuloplasty and preputioplasty (**Keramidas** and **Soutis** 1995) was developed.

This procedure is based on the **amenability of the urethra to mobilization and advancement to the glans tip** (**Koff** 1981; **Hamdy et al**. 1999; **Caione et al**. 1997).

Distal hypospadias is a commonly encountered anomaly. Since its innovation by Duckett the MAGPI procedure has become almost the standard operation for the correction of minor cases. Recently case selection has been advised to avoid possible complications and limitations.

The main **indications of urethral mobilization and advancement** were:

1. The presence of glanular chordee.
2. Failed MAGPI.
3. Circumcised children with distal hypospadias.
4. Immobile fibrotic urethral meatus.
5. As an alternative to MAGPI.

Embryology:

Abnormal morphogenesis in hypospadias affects three main anatomical features resulting in:

1. The ectopic urethral orifice.
2. The abnormal foreskin, including irregular penile raphe and dorsal hood
3. The chordee or congenital band in the penis observed on erection (**Stephens et al**. 2002).

Ectopic orifice:

The primary anomaly in nearly all cases of hypospadias is failure of the midline perineal mesenchyme to grow ventrally to cover the urethral plate as it canalizes. Incomplete morphogenesis is the commonest embryological defect, and in hypospadias the opening of the urethra is commonly arrested at or near the coronal groove of the glans. This position is normal in 9 and 10 week human embryos (**Clarnette et al**. 1997). Where the opening is more proximal on the penile shaft or in the perineum, it suggests a more severe local anatomical anomaly or defect in androgenic action. The most proximal opening in the perineum, representing the original opening of the urogenital sinus and the normal site of the urethra in females, is seen in complex anatomical defects of perineal morphogenesis (often with imperforate anus) or in forms of intersex.

Failure of urethral plate to be covered by mesenchyme(and skin) leaves the outer genital folds separated as two hemiscrota. An open midline gutter with pin point orifices of presumed Littre's glands distal to the ectopic orifice indicates the persisting urethral plate.

Dorsal Hood and Raphe:

The dorsal hooded prepuce is characteristic of hypospadias and may be explained by failure of androgen-dependent growth of the ventral penile mesenchyme. This leaves a wedge shaped defect in the ventral prepuce, including an absent frenulum. At each corner of the dorsal hood, the bifurcated penile raphe ends in a "dog-ear". The dog ears represent the most distal points of external prepucial skin that would normally be joined together. In the more severe form of hypospadias where the dorsal skin of the penis remains fused with the scrotal folds, there are no dog-ears.

The median raphe of the phallus is abnormal in hypospadias. Deficiency of mesenchymal growth along the shaft may lead to a zigzag course of the raphe. Just proximal to the ectopic orifice the raphe bifurcates, with each branch continuing distally to the dog-ears on the prepuce. These raphe branches indicate the distal edge of migration of the mesenchyme that forms the Buck's fascia and subcutaneous tissue, which are lacking in the triangular area between the branches. In cases where the raphe bifurcates some distance proximal to the

orifice, the urethra is very superficial and lacks adequate supporting tissue and corpus spongiosum.

Chordee:

Chordee is present in most patients with hypospadias, but is related to the severity of the underlying anomaly. In more distal variants, the arrest of mesenchymal growth and/or the initiation of apoptosis occur later, leading to progressively less severe chordee, with most of the chordee caused by deficient periurethral growth rather than a bend in the corpora. In glanular hypospadias, chordee may also result from deficient growth of the distal urethral plate (**Ben-Ari et al**. 1985), although the appearance of a short urethral plate may simply result from relatively greater growth of the dorsal side of the developing glans.

Genetic Aspects:

The heritability of hypospadias is well recognised, and recurrence risks suggest that brothers of an affected individual have 6-17% chance of also being affected. There have been reports of males with chromosomal anomalies who have hypospadias as a feature. Hypospadias was found to be significantly associated with deletion of chromosomal bands 1q42-44, 4p16-13,7q34 and 11p13 and duplication of bands 2q35-37,8q12 and 16q21-24.

Hypospadias is usually an isolated anomaly but it is estimated that 10-15% of patients with this condition have additional congenital malformations,

particularly affecting the urogenital system. Some of them will have recognisable and detectable chromosomal abnormalities. Karyotyping should therefore be considered in children who have hypospadias in addition to other anomalies.

Anatomical Considerations:

Surgical repair of hypospadias requires an expert understanding of the normal anatomy of the penis as well as an understanding of the anatomy of the hypospadiac penis. Compared with normal penis, the anatomy of the hypospadiac penis is no different in terms of neuronal innervations, corpora cavernosa and tunica albuginea architecture, and blood supply, except at the region of the abnormal urethral spongiosum and glans.

The most striking difference between the normal penis and the hypospadiac penis is a difference in vascularity. The hypospadiac penis has huge endothelium-lined vascular channels filled with red blood cells. In contrast, the normal penis has well defined, small capillaries around the urethra, fanning into the glans. Anatomic studies of the urethral plate show no evidence of fibrosis or scarring. The urethral plate is well vascularised, has a rich nerve supply, and has an extensive muscular and connective tissue backing. These features may explain the success of incorporating the urethral plate or abortive spongiosum into hypospadias reconstruction.

REVIEW OF LITERATURE

Prof Anthony Atala et al. did a prospective study on urethral mobilization and advancement for mid shaft to distal hypospadias[4] at the Department of Urology, Children's Hospital, Harvard Medical School, Boston, Massachusetts. The authors studied a total number of 73 boys age ranging from four months to twelve years over a period of six years. Urethral mobilization and advancement procedure was done for the repair of glanular (14 cases), subcoronal (38 cases) and midshaft (20 cases) hypospadias. Chordee was present in 37 boys. The penile skin was degloved and chordee was corrected. The urethra was mobilized approximately thrice the length between the original meatus and the tip. They created glans wings and brought the urethra to the tip and approximated the glans wings over the urethra. The urethral catheter was left overnight. The follow up period ranges from six months to six years. In this study none of the patients had an urethrocutaneous fistula or meatal stenosis. There were no episodes of new, persistent or recurrent chordee. Two patients had meatal retraction wherein the urethra migrated proximally but still within the glans. Only one of these patients required a second procedure. One patient had a haematoma that resolved spontaneously. The authors concluded that the urethral mobilization and advancement procedure can be useful for repair of midshaft to distal

hypospadias with or without chordee with minimal complications and excellent cosmetic results.

A study was done by **Caione P** and **Capozza N** at the division of Pediatric Urology, Bambino Gesu Children's Hospital, Rome, Italy on distal hypospadias repair by urethral sliding advancement and Y-V glanuloplasty[6]. They developed a technique of distal urethral advancement glanuloplasty operation that is specifically intended for distal hypospadias repair even with mild chordee. Mobilization of the distal urethra is performed for 1.0 to 1.5 cm. after subcoronal circumcision and a deep Y-shaped incision of the glans. The mobilized urethra is dorsally split and slid forward to the tip of the dart of the glans previously prepared. Glanuloplasty is performed using the 2 lateral flaps of glans tissue. From January 1987 to December 1989 they used this technique in 74 cases of distal hypospadias with mild or no chordee (patient age 18 months to 9 years, mean 3.5 years). A transurethral catheter was left indwelling for 3 to 4 days. Hospitalization time was five (± 1.5) days. Results after 4 to 40 months of followup are encouraging both cosmetically and functionally. All patients were cured. In 3 cases (4%) meatal stenosis was occurred requiring meatotomy and in 8 boys meatal dilations were performed on an outpatient basis. In one case (1.3%) a fistula developed, which was subsequently repaired without further complications. As per the author’s contention this operation may be successfully

used in most cases of distal hypospadias, with a low complication rate and excellent cosmetic results. It also may be used if mild chordee is present, thus reducing the indications for flip-flap urethroplasty in those cases when meatal advancement procedures may not be effective.

Another study done by **Awad Mohamed M.S** at the Department of Plastic Surgery, Zagazig University, Zagazig, Egypt on urethral advancement technique for repair of distal penile hypospadias[5]: A revisit. This study was done on 72 patients, 19 cases with glanular hypospadias, 20 cases with coronal hypospadias, 22 cases of subcoronal hypospadias, and 11 cases with anterior penile hypospadias in the period between September 1999 and October 2003. The patient's age ranged from two years to twenty five years (median age 5.6) years. All the patients were operated using Chang's technique with some modifications. These modifications were: 1.Start mobilization of the urethra within the corpus spongiosum from the ventral penile skin and the corpora cavernosa of the penis, from the middle part instead of the original dissection from the tip that is difficult and leads to excessive bleeding. 2. Trimming the distal urethra in an oblique fashion about 1-2 mm more on the ventral aspect. 3. Take a vertical slit instead of a transverse slit of the glans. 4. Closure of the skin is done with 6/0 chromic catgut. In this study the author noticed that the urethra can be advanced until 0.5 cm in patients with distal hypospadias aged from two to five years, about 1 cm in those aged from six to ten years and about 2.5 cm for those more than ten years.

The time consumed to dissect the urethra until its tunneling and fixation to the glans ranged from 30 to 60 minutes with an average time of about 45 minutes. One more advantage over other procedures the author claimed is that it does not need other tissues for covering the urethra. There is also no anastomosis between the urethra and the neo urethra, which can be a potential site for leakage and fistula formation. Further, the chordee (whatever its extent) has no influence on the procedure of advancement and can be corrected during the operation.

There were no major complications in any of their patients, no postoperative fistulae or urethral stricture. Three patients had meatal stenosis and preputial edema occurred in non-circumcised patients. None of the patients had major complications, dehiscence, stricture or fistula. The most common minor complications were preputial edema (34.7%) not responding to any therapy. Problems immediately after surgery were rare; seventeen children (23.6%) had minor problems. Of these two had difficulty in voiding, which was relieved with hot fomentation. Four patients had wound infection, five patients developed penile haematomas and three had significant meatal stenosis which was relieved with a dilator twice weekly for two weeks. At the review soon after repair the urinary stream was satisfactory in all but three children who had postvoid dribbling caused by crust and was relieved conservatively. So this author's conclusion is that urethral advancement and mobilization technique with little

modifications through the mobilization of the urethra starting from its middle part and tangential cutting of the distal 2 mm of the urethra and vertical slitting of the glans is a simple technique. This method can be easily learnt, it is a rapid procedure giving the best cosmetic results with least complications. They prefer it to be done for repair of distal penile hypospadias as the best choice keeping in mind the relation between the patient age and the mobilized urethral distance needed.

Another study on Urethral advancement technique for repair of distal hypospadias[22] by **Wishahi MM** and **Wishahi MK**, claimed eighty children with distal hypospadias were operated upon by this technique. It is a modification from the old Beck technique and is applicable only for distal types (coronal and subcoronal) with minimal chordee and rotation. The urethral meatus could be placed to the tip of the glans penis by mobilizing and advancing the urethra without constructing a neourethra. Children did not need catheterization or diversion. The average hospital stay was 2 days. Success rate was 98%. Children who developed fistulae were treated by simple closure of the defect.

Karamursel S and **Celibioglu S** carried out this urethral advancement procedure for recurrent distal hypospadias fistula[15]. They contended that hypospadias fistula may be persistently recurrent in some patients. In distal hypospadiac fistula cases, carrying the fistulous opening to the glans tip may be

possible with extensive urethral mobilization and advancement. In 9 patients who were operated for urethrocutaneous fistula, the authors used the urethral advancement technique. Patients age ranged from 5 to 14 years (mean, 8 years). In all of the cases, the urethra was mobilized proximally to at least penoscrotal junction, and in some cases, the bulbar urethra was mobilized partially. Follow-up ranged from 6 months to 16 months. In all but one child, a straight penis with the neomeatus at the glans tip was maintained without any urethrocutaneous fistula. In one child, chordee which was already present could not be prevented. The authors of this study concluded that urethral advancement technique may effectively solve the problem of persistently recurrent hypospadias fistula and further recommend this technique to plastic surgeons' armamentarium.

Another popular article was published by **Keramidas DC** and **Soutis ME**, on urethral advancement, glanuloplasty and preputioplasty in distal hypospadias[16]. One hundred and thirty boys with subcoronal (78 cases) and glanular (52 cases) hypospadias were submitted to Urethral Advancement, Glanuloplasty and Preputioplasty. The main steps of the operation were the following: blunt dissection and mobilization of the urethra as extensively as needed to reach the tip of the glans without tension; embedding of the urethra into a groove of the glans created by excision of tissue between two incisions converging from each side of the primary meatal location up to the tip of the glans; fixation of the meatus up to the tip of the glans and suturing of the glanular

flaps over the mobilized urethra; shaping the foreskin to normal appearance. Reconstruction was uncomplicated in 117 patients (90%). Postoperative fistulae and urethral retraction to an abnormal position occurred in 7 and 6 cases respectively. All meatal retractions and 2 fistulae next to the meatus were dealt with successfully using the Mathieu procedure. On the basis of this experience the authors conclude that the technique is applicable to any type of distal hypospadias regardless of the severity of glandular ventriflexion, it is amenable to the Mathieu procedure in case of failure and gives good functional and cosmetic results.

Chang TS published anterior urethral advancement: a one-stage technique for hypospadias repair[7]. This paper presents a technique of repairing congenital hypospadias by a one-stage method using the principle of advancement of the anterior urethra. It can also be applied in the secondary repair of urethral strictures or fistulae. He claimed that no urinary diversion is necessary and it eliminates the possibility of post-operative urethral stricture or fistula formation which is frequent complications of the more classical procedures and the repair can be completed in one stage. The clinical details of 16 patients in whom this technique was successfully used are presented in that article.

The Urogenital Research Unit, State University of Rio de Janeiro, Rio de Janeiro, Brazil, released an article by **Alexandro Da Silva E** and **Francisco J.B**

Sampaio on urethral extensibility applied to reconstructive surgery[3], based on a study done on human cadavers. The human male urethra has great capacity to extend under traction. This extensibility is the principle of surgical techniques used to overcome urethral defects and for penile lengthening. However, the safe limits of urethral extensibility in reconstructive surgery have not been yet established by a morphological study. To this end they measured fresh human cadaveric urethras with and without traction. They analysed the macroscopically normal, fresh cadaveric urethra from 25 men 6 months to 73 years old at death (mean age 30.6). Penile length and length of the total, penile, bulbar and membranous urethra were measured. Length under maximal constant traction and the maximal stretched length without penile curvature at artificial erection were determined. Extensibility is expressed as the percent of the variation in initial length at rest and maximal constant traction length. Maximal stretched length without penile curvature at artificial erection is expressed as a percent of maximal constant traction length. The authors found that the total urethral extensibility was higher than penile extensibility ($p < 0.001$). The Urethral extensibility decreased with aging ($r = -0.806$, $p < 0.001$). Mean extensibility of the whole male urethra was 66.2% ± 7.2% and differences among urethral segments were not significant ($p = 0.283$). Mean maximal stretched length without penile curvature at artificial erection was 75.2% ± 3.8% and it did not change with age.

Based on this study the authors concluded that the safe anatomical limit of urethral extensibility applied to reconstructive surgery may avoid complications and the necessity for more complex techniques. This limit should be approximately 75% of the maximal constant traction length or a gap-to-normal urethra ratio of 1:4. However, age related variations should be considered.

A study on urethral advancement and glanuloplasty vs. meatal advancement and glanuloplasty incorporated for distal hypospadias repair[13] was done by **Jawad A J.** at the department of Surgery, King Saud University, College of Medicine, Riyadh, Kingdom of Saudi Arabia. Between April 1986 and April 1995, 153 boys were treated for distal hypospadias. In 51 patients (coronal 31, subcoronal 20) a modified technique of urethral advancement and glanuloplasty has been used. The main indications of this urethral advancement and glanuloplasty were the presence of glanular chordee (7 cases), failed MAGPI (3 cases), circumcised children with distal hypospadias (7cases), immobile fibrotic urethral meatus (5 cases), and as an alternative to MAGPI (29cases). The overall complication rate was 4% compared to 3.8% with the MAGPI procedure which has been used in the treatment of 102 patients (glanular 50, coronal 47, and subcoronal 5). The authors feel that this technique can be used effectively in patients with coronal and subcoronal hypospadias, particularly in the presence of distal chordee, fibrotic immobile urethral meatus or MAGPI limitations. Also

urethral advancement and glanuloplasty could be a useful alternative to MAGPI where tension-free urethral advancement and glanular wrapping can be achieved.

Harrison DH, **Grobbelaar AO** of RAFT Institute of Plastic Surgery, Mount Vernon, Northwood, United Kingdom did a retrospective study on urethral advancement and glanuloplasty a modification of the MAGPI procedure for distal hypospadias[12]. Forty-seven patients, who had this operation from 1985 to 1994, have been reviewed. The overall complication rate was low with a 2.1% fistula rate and a 6.4% incidence of meatal retraction. Only one patient required secondary surgery.

H. Hamdy and **M.A.Awadhi** did a study on urethral mobilization and meatal advancement[11]: a surgical principle in hypospadias repair from September 1994 to august 1997. Urethral mobilization and advancement was used in the management of hypospadias in 56 children whose ages ranged from 1to 5 years (average 3.8 years). In 46 children the meatus was coronal (27cases), subcoronal (12 cases) and distal penile (7 cases); in this group urethral mobilization was the only procedure. In 10 cases of proximal hypospadias, urethral mobilization was combined with another technique; Duckett's transverse preputial flap in 4, Thiersch-Duplay-Monfort urethroplasty in 4 and Onlay island flap in 2. The reported patients have been followed for 6 months to 3 years (average 1.8 years). Meatal stenosis occurred in 4 children, all of whom had the mobilized urethra

tunneled through the glans. Two responded well to dilatation and one needed meatoplasty. One child with distal penile hypospadias developed a noticeable penile curvature on erection, requiring reoperation. The urethra, which initially was not sufficiently mobilized, was separated and mobilized more proximally, obtaining more length and resulting in correction of curvature. In one child the urethra was injured during dissection. It was immediately sutured using 7/0 PDS. No fistula occurred in the 46 operated children with coronal, subcoronal and distal penile hypospadias, including the one with urethral injury. In 10 children with proximal penile hypospadias who had urethral mobilization combined with other procedures, fistulae occurred in three. Two of four urethral mobilization operations combined with a Duckett's transverse preputial flap and one of two with Onlay island flap. The final outcome of all the operated was functionally and cosmetically excellent; they all voided easily with a straight stream and no chordee.

A study done by **Haberlik A**, **Schmidt B**, **Uray E**, **Mayr J**. at the Department of Pediatric Surgery, Karl-Franzens-University Medical School, Graz, Austria on Hypospadias repairs using a modification of Beck's operation[10]. The authors reviewed the results of 64 cases of hypospadias repair using a modified Beck's operation with mobilization of the anterior urethra. Patients age at correction ranging from 10 months to 12 years (mean 3.83 years). Six patients

had undergone previous surgical treatments. Uroflowmetry and evaluation of the urinary stream, meatus, glans, shaft and scar formations were used as objective criteria, and grading of management and results by parents was considered subjective criteria. An average of 2.1 years postoperatively 59 patients were available for this followup study. The urethral meatus was positioned satisfactorily onto the distal glans in all cases and no urethrocutaneous fistulas developed. Meatal stenosis requiring meatal dilation occurred in 2 boys. In 2 cases a curved glans, and curved penis and glans, respectively, were caused by cicatricial tissue, necessitating surgical correction. Uroflowmetry was possible in 46 cases (78%). One patient with meatal stenosis had pathological flow values. All other flow rates were within the normal range. In the second case of meatal stenosis objective evaluation was impossible. In 55 cases (93%) parents judged management and results as optimal. Based on this study the authors concluded that mobilization of the anterior urethra for correction of distal hypospadias with or without chordee is highly successful, less extensive, and provides an excellent cosmetic and functional result with a minimal risk of complication. Uroflowmetry is a noninvasive, objective diagnostic tool for evaluating the functional results of hypospadias repair.

Another study done by **Roodsari SS**, **Mulaeian M**, and **Hiradfar M**. at the Department of Pediatric Surgery, Mashhad University of Medical Sciences,

Mashhad, Iran on urethral advancement and glanuloplasty with V flap of the glans in the repair of anterior hypospadias[19]. A total of 74 boys with anterior hypospadias underwent the procedure of urethral advancement and glanuloplasty with V flap of the glans in their medical centre between March 1994 and March 2000. The procedure included degloving, correction of chordee, urethral mobilization and glanuloplasty. Cosmetic results were excellent in most patients. There was no fistula, and meatal stenosis was also not observed after applying V flap of the glans. In a 1-6 year followup (mean +/- SD, 3.15 +/- 1.79 years) the results were functionally and cosmetically satisfactory in all cases, with no long-term complication or chordee. Their findings suggest that urethral advancement and glanuloplasty with V flap of the glans is an excellent technique for repairing anterior hypospadias with satisfactory results and low complication rate.

A study was done by **Marzouk E**. on fistula management by urethral advancement procedure in the treatment of selected cases of persistently recurrent urethrocutaneous fistula following distal penile hypospadias repair[17] at the Urology Department, Faculty of Medicine, Alexandria University, Egypt. This paper describes a urethral mobilization procedure as a new way to solve this problem. The procedure was performed on seven children suffering from recurrent hypospadias fistula that had failed more than once to be repaired by the classic ways of closure. Selection of suitable cases should be done preoperatively

when urethral mobilization has successfully allowed the fistula opening to easily reach the glans tip. The described procedure is an extensive urethral mobilization that advances the fistula opening to the neomeatus at the glans tip through a glanular tunnel. The operation resulted in a straight penis with the neomeatus at the glans tip in all seven children, without complications, over a period of 6-18 months follow up. The fistula advancement operation, as it is called by the author, can, in selected cases, solve the problem of persistently recurrent hypospadias fistula with a high success rate.

A study by **Dindar H**, **Cakmak M**, **Yucesan S** and **Barlas M**. at the Department of Paediatric Surgery, Medical Faculty of Ankara University, Cebeci, Turkey on distal penile hypospadias repair in children, with complete mobilization of urethra and triangular glandular flap[9]. Sixteen children (average age 6.6 years) were treated between January 1985 and January 1991 by this procedure. One child developed a mild meatal stenosis and another had a small urethral fistula; both responded to treatment. Results were excellent in the remaining 14 patients. As per the author this simple operative procedure was successful in the majority of patients and there were only two minor complications.

Spencer JR and **Perlmutter AD** did study titled "Sleeve advancement in distal hypospadias repair"[20] at the Department of Pediatric Urology, Children's Hospital of Michigan, Detroit. They report the technique and late results of a

procedure for selected cases of distal hypospadias called sleeve advancement urethroplasty. This procedure incorporates correction of chordee, distal urethral mobilization and glansplasty in patients with coronal or distal subcoronal hypospadias. A total of 69 boys underwent this procedure at their institution: 59 as a primary repair and 10 for correction of meatal retraction after a previous failed reconstruction. Cosmetic results were excellent in most patients. Complications included meatal retraction in 2 patients and mild meatal stenosis in 2 in the primary repair group, and meatal stenosis in 3 (with associated fistula in 1) in the secondary repair group. Although not a replacement for meatal-based flap procedures, and more tedious to perform than the meatal advancement and glanuloplasty procedure, the authors have been impressed with the superior cosmetic results and minimal morbidity of the sleeve advancement urethroplasty.

De Sy WA, **Hoebeke P** presented a study titled "Trans-glandular urethral advancement for distal hypospadias-16-year experience" [8]. This study was done at the department of urology, Clinical university of De Pintelaan , Gand, Belgium. Eighty six patients where operated by the urethral transglanular advancement technique. They modified the reconstruction of the meatus to prevent the uncosmetic appearance of the meatus, resulting from the initial technique. The results were excellent. In 40 patients (23 adults and 17 adolescents) they were able to judge the appearance and function of their adult penis with a follow-up of at least 7 to 16 years after the intervention. In

conclusion, the authors thought that the fear of ischemia and retraction or even necrosis, with secondary late chordee, after extensive urethral mobilization, is unjustified.

Another study was done by the **Paolo Caione et al**. at the Pediatric Urology, Department of Surgery, Bambino Gesu Children's Hospital, Rome, Italy[18]. This study was done from January 1987 to December 1992, which includes total number of 271 boys with age ranging from 9 months to 14 years (mean age 2.5 years). This included distal, coronal and subcoronal hypospadias. Among these distal urethral advancement and glanuloplasty was done in 135 (49.8%) cases. The long-term results in 118 cases were determined at 4 to 9 years of followup (mean 6.3). In 112 cases (95%) good functional and cosmetic results were achieved, while in 6 (5%) complications required surgical repair, including meatal stenosis in 3 (2.5%), fistulas in 2 (1.7%) and complete glanuloplasty disruption in 1. They also evaluated the outcomes in 19 postpubertal patients 15 to 20 years old and noted no psychological or sexual problems as a consequence of hypospadias repair. In the authors view, this study confirms the validity of distal urethral advancement and glanuloplasty for correcting a large number of coronal and subcoronal hypospadias cases.

Uroz Tristan J, **Garcia Urguelles X**, **Cruz Benavides F**, **Sanchis Solera L**, **Lopez Pinto-Ruiz J** and **Alonso Jimenez L** analysed of 34 cases of

distal hypospadias treated by modified Koff's technique[21] at the Department of Paediatric surgery, Hospital for Maternity and Infants, Las Palmas de Gran Canada. Koff's procedure was done in the treatment of distal hypospadias which consist of a large mobilization of the distal urethra. The association to a transglanular tunnelisation and minimal urethroplasty is useful for the treatment in the majority of patients with distal hypospadias. In the last two years 34 patients with distal types of hypospadias were operated with a Koff's modified procedure. The technique consists of urethral advancement without glanuloplasty and distal cutaneous tubulization. The primitive meatal localization was subcoronal (n = 22), glandular (n = 6), and on the distal shaft (n = 6). In 10 cases urethral catheters was not necessary. A patient develops a proximal fistula successfully treated with 14 days catheterization. Cosmetic and functional results were good in all cases. Extensive urethral mobilization can be done in cases of distal hypospadias and is evidence of the preserved vascularity and viability of the mobilized urethra.

An article in the book titled “Hypospadias Surgery-an illustrated guide” authored by **Ahmed T.Hadidi** and **Amir F. Azmy** (Eds.) described apart from the procedure the complications following this urethral mobilization and advancement procedure[1]. The postoperative complications are urethrocutaneous fistula (12%) due to urethral damage during dissection and urethral retraction (26%) due to inadequate mobilization. The postoperative complications were

easily dealt with by reoperation using the Mathieu procedure. The advantages of the procedure as claimed by this book are a. applicability to almost any type of distal hypospadias b. normal appearance of the penis c. good functional results. The disadvantage is both operation time and hospital stay are longer.

AIM OF STUDY

The aim of this study is to evaluate urethral mobilization and advancement procedure in the management of different types of distal hypospadias and analyse the results.

MATERIALS AND METHODS

This prospective study was done from **October 2004** to **March 2006** over a period of eighteen months. Urethral mobilization and advancement procedure was used in the management of distal hypospadias in 25 children whose ages range from 11 months to 10 years. Children with glanular, coronal, subcoronal and distal penile variety of hypospadias was chosen for this study. Most of the cases were operated by a single surgeon. All the children were non circumcised individuals. Cases with proximal penile and mid penile variety of hypospadias were excluded from this study. Ultrasonagram of abdomen was done in all cases to rule out associated urogenital anomalies.

In two children this procedure was done at the age of 11 months. The meatus was glanular in two children, coronal in six children, subcoronal in ten children and distal penile in six children. Among the 25 cases 2 children were failed cases, whom had already undergone other surgical procedures for distal hypospadias now presenting with persistent hypospadiac meatus. The above mentioned patients have been followed for six months to two year.

Procedure:

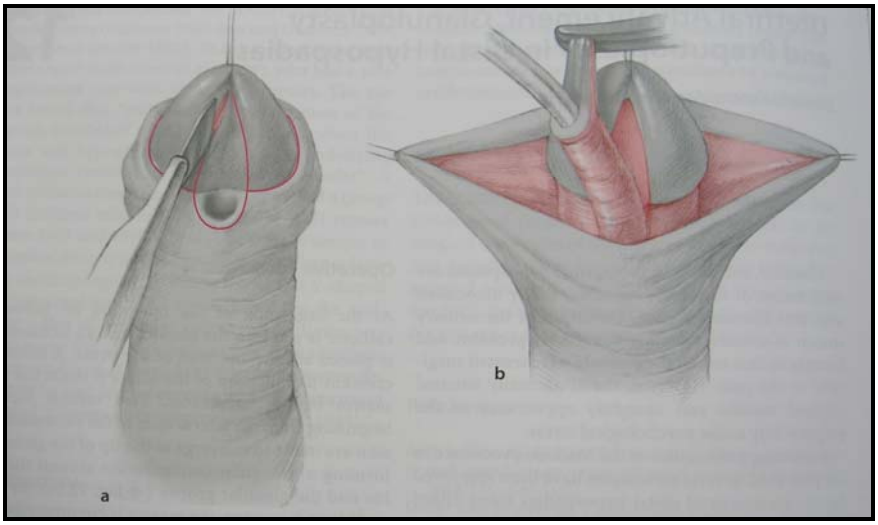
With the patient under general anesthesia, a traction suture was placed through the glans. An 8 F size infant feeding tube was passed into the bladder. Epinephrine 1: 200,000 dilution was injected along the incision lines. An artificial erection test was done to demonstrate the degree of chordee in all questionable cases. A circular skin incision was made ventrally circumcising the urethral meatus and leaving 3-4 mm surrounding skin attached (Fig.1&2). If the corpus spongiosum surrounding the meatus was thin, it was excised. The penile skin was dissected free along Buck's fascia and slid toward the base of the penis. The urethra was dissected along the plane of cleavage between the spongy tissue of the urethra and corpora cavernosa (Fig.3). Any fibrous bands distal to the meatus that might contribute to a degree of chordee were excised. Care was taken not to enter or injure the urethra. The separated urethra was measured against the straight penis to determine if it would reach the tip of the glans without tension. The mobilized urethra should be checked against the artificially erected penis to ensure that sufficient length has been obtained. A ratio of **1:3** is recommended i.e., to bridge 1 cm gap 3 cm urethral mobilization is needed (Fig.4). (In proximal hypospadias also this urethral mobilization and meatal advancement is useful as it can shorten the gap to be bridged or to be combined with procedures that preserve and utilize the urethral plate in the formation of the neourethra).

Then a wide glanular tunnel was made to transmit the mobilized urethra. The skin rim around the meatus was anastomosed to glans using 6/0 polypropylene sutures. If the end of the urethra was trimmed due to insufficient spongy tissue, we preferred not to tunnel it but to create triangular glans flaps. The mobilized urethral meatus was spatulated and anastomosed to the central triangular flap; the lateral glanular wings were wrapped around it (Fig.5). This technique creates a wide meatus and gives good coverage of the mobilized urethra. At present, the triangular flaps have replaced the tunneling procedure in all cases.

The degloved penile skin was pulled back and sutured to the circumferential rim of inner preputial skin along the coronal sulcus. The penis was dressed using a sponge compression dressing and urethral catheter was sutured to the glans penis (Fig.6). The catheter was removed usually on the sixth post operative day and the child was discharged once he voids urine.

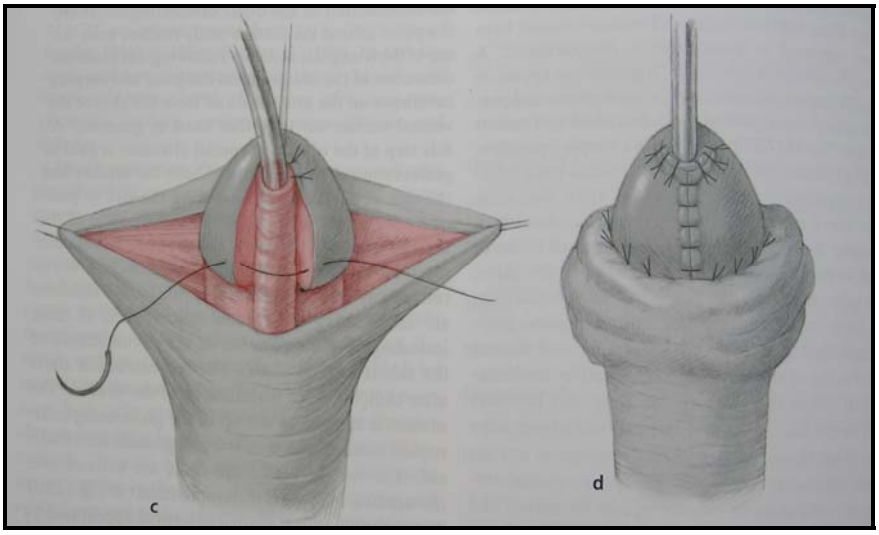
Another technique for the initial mobilization of urethra is described in literature (Fig.8). Here a submeatal crescent-like incision of the skin is made few millimeters below the meatus. Two vertical incisions beginning from the lateral ends of the submeatal incision are made to converge at the tip of the glans, thus forming a triangular configuration around the meatus and glanular groove. By sharp and blunt dissection, the meatus is circumscribed and the mobilization of the distal urethra begins. The further mobilization of urethra from the corpora is same as that of previous procedure.

Fig.8. Urethral Mobilization and Advancement (Keramidas)



a. Triangular configuration of incisions around the meatus

b. Dissection of urethra from the glans, corpora & ventral skin



c. Fixation Meatus to the tip of the glans & reconstruction of glans.

d. Preputioplasty

RESULTS

This study includes a total number of 25 cases over a period of 18 months from October 2004 to March 2006. Total number of hypospadias cases admitted in this hospital during this period was 77, which includes all types of hypospadias. Among the 77 cases of hypospadias distal variety of hypospadias comprises 56 (72.7%) cases and proximal variety includes 21 (27.3%) cases. In the 56 cases of distal hypospadias 25 (44.6%) cases underwent urethral mobilization and advancement procedure. The rest of 31 (55.4%) cases underwent different procedures by different surgeons and are not included in this study.

The age group of the patients who underwent urethral mobilization and advancement ranges from 11 months to 10 years (Fig.9). Two patients belong to less than one year age group (8%), six patients belong to 1 to 2 year age group (24%), twelve patients belong to 2 to 5 year age group (48%) and five patients belong to more than 5 years age group (20%).

Among the 25 cases that underwent urethral mobilization and advancement, glanular hypospadias comprises three (12%) cases, coronal hypospadias comprises six (24%) cases, subcoronal hypospadias comprises ten (40%) cases and distal penile comprises six (24%) cases (Fig.10).

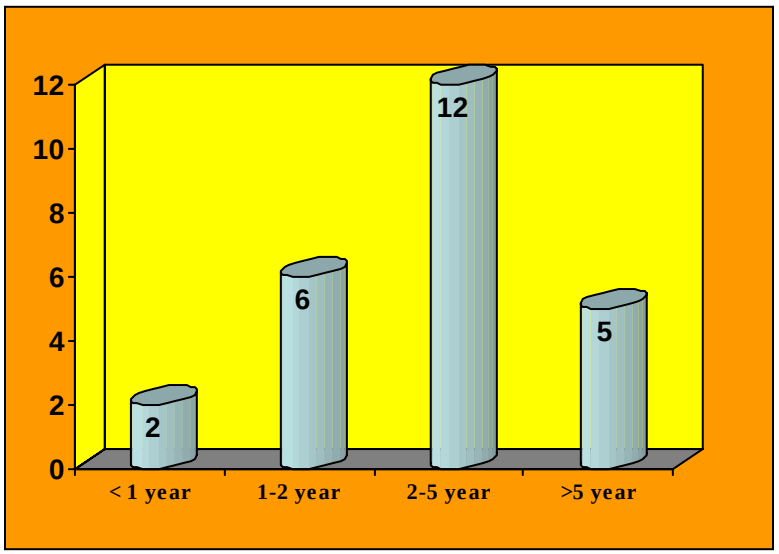


Fig.9. Age Incidence

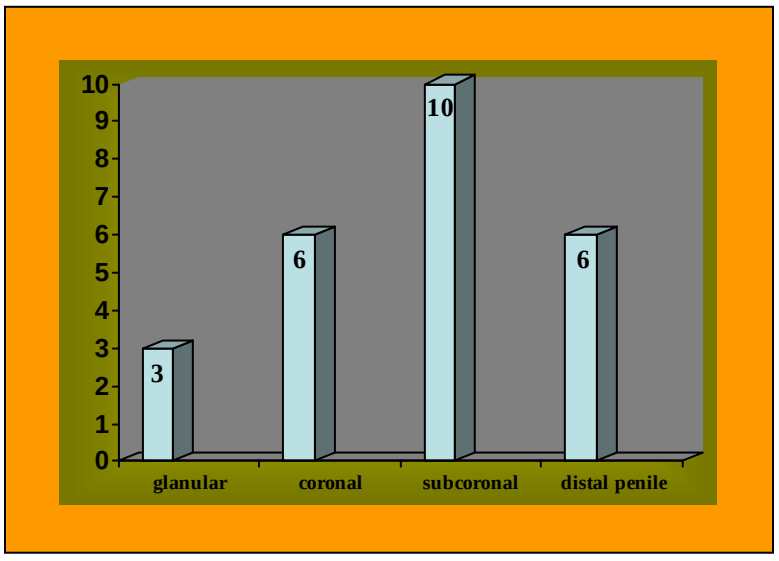


Fig.10. Types of Hypospadias

In the study of 25 cases, thirteen cases had associated findings (Fig.11). Eight cases had associated chordee (32%), three cases had associated meatal stenosis (12%) and two cases are failed cases (8%) following various previous procedures done for distal hypospadias. Among the two failed cases one case underwent MAGPI for glanular hypospadias and now presented with meatus at the subcoronal level and other case underwent Snodgrass procedure for subcoronal hypospadias now had meatus at the distal penile level.

Among the eight cases with associated chordee, one case belongs to glanular variety, one case belongs to coronal variety, three cases belongs to subcoronal group and another three cases belongs to distal penile variety. Among the three cases associated with meatal stenosis two had glanular hypospadias and one case had subcoronal hypospadias. Ultrasonagram of abdomen was normal in all cases.

All the twenty five children in this study underwent urethral mobilization and advancement procedure as described earlier. In five cases the mobilized distal urethra was tunneled through the glans and in twenty cases glans wings were created and approximated over the mobilized urethra after bringing the neomeatus to the tip of the glans.

Among the 25 cases those who are treated by urethral mobilization and advancement, 21 (**84%**) cases had successful outcome. There was no meatal

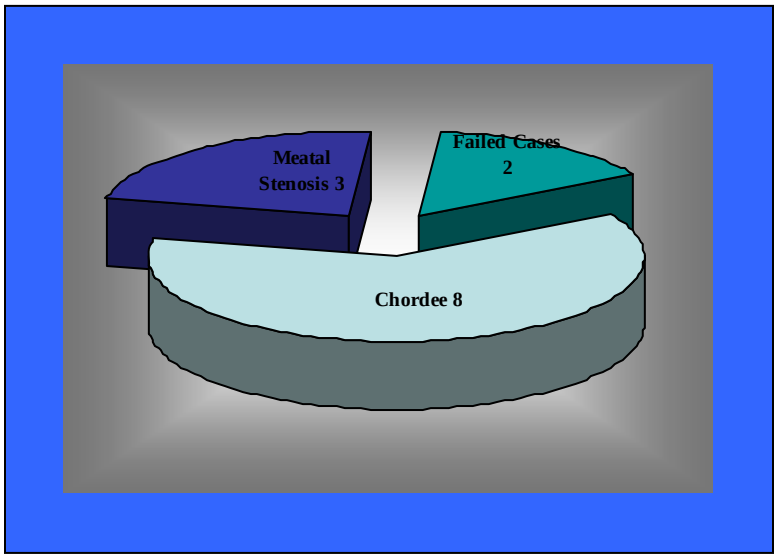


Fig.11. Associated Findings

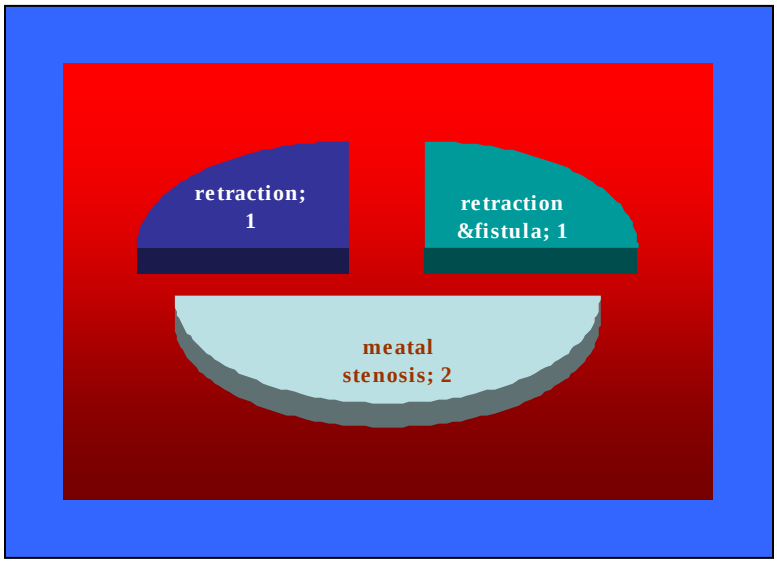


Fig.12. Complications

stenosis, no urethrocutaneous fistula and no meatal retraction. The urinary stream was straight and single. The meatus was seen at the tip of the glans and the parents and the children were satisfied with the appearance of the penis.

The followup period ranges from six months to two years. Four (16%) cases met with complications in this series (Fig.12). All the four complications occurred in the early part of this study. In two (8%) cases the complications occurred in the postoperative period itself. One six year old child had retention of urine and retraction of the neomeatus on sixth postoperative day following catheter removal. In another five year old child developed meatal retraction, scrotal edema and urethrocutaneous fistula on catheter removal. Two (8%) children one five years old and other seven year old developed meatal stenosis in the third month following urethral mobilization and advancement procedure.

In this study the overall hospital stay ranges from six days to thirteen days (average 6.6 days). In twelve (48%) cases the hospital stay was six days, in eight (32%) cases it was seven days and in three (12%) cases the hospital stay was eight days. In two (8%) cases the hospital stay was thirteen days. Based on the length of urethra to be mobilized the operating time for this procedure ranges from forty five minutes to sixty minutes.

DISCUSSION

A total of 77 children with hypospadias were admitted from October 2004 to March 2006 at the Institute of Child Health and Hospital for Children, Chennai which accounts for 0.13% of our hospital admissions. Among the 77 children 25 (32.4%) children underwent urethral mobilization and advancement procedure.

In this study the average age of the children who underwent urethral mobilization and advancement procedure was 3.6 years. As per the literature the average age of the children underwent this procedure was 5 years. Most of the cases in this series belong to less than 5 year age group i.e. 80% (20). Among the under five age group children 2-5 years age group comprises 48 % (12). This study also includes 2 (8%) children below one year of age. According to the literature in most of the series urethral mobilization was done after 10 months of age except **Prof. A.Atala**, he did urethral mobilization in a four months old child and **Prof. Paolo Caione** included nine months old children for urethral mobilization in his study.

The most common variety of distal hypospadias noted in this study is subcoronal variety. In the 25 cases 10 (40%) cases belongs to subcoronal variety, glanular 3 (12%) and coronal and distal penile each comprises 6 (24%) cases. This fact is in concurrence with the literature.

The most common associated finding in this study is chordee which is present in 8 (32%) cases and next is meatal stenosis 3 (12%) cases. Literature also quotes that even though chordee was minimal in distal hypospadias it was the most common associated finding. Chordee was seen in 50% (37) of cases in **Prof. Anthony Atala's** study. Ultrasonagram abdomen was done in all cases to rule out associated urogenital anomaly and there were no such associated findings in this study. As per the literature associated urogenital anomaly is more common with proximal hypospadias only.

Adequate mobilization of the urethra is an important factor in preventing meatal retraction. The separated urethra was measured against the straight penis to determine if it would reach the tip of the glans without tension. The mobilized urethra should be checked against the artificially erected penis to ensure that sufficient length has been obtained. In our study in all the 25 cases we mobilised the urethra proximally in a ratio of **1:3** i.e. to bridge a 1 cm gap between hypospadiac meatus and glans tip we mobilised urethra to 3 cms. Most of the literatures agree with this 1:3 mobilization. In a study done at Zagazig university (**Awad Md**.) the length of the urethral mobilization was based on the age of the child, 0.5 cm for 2-5 age group, 1 cm for 6-10 year group and 2.5 cm for more than 10 years old children. In our study we had two cases of meatal retraction probably inadequate urethral mobilization is the cause for this retraction. In literature reports there was one study (**E.Alexandro Da Silva**) on human cadaver

on the urethral extensibility. The author found the total urethral extensibility was higher than the penile extensibility and this urethral extensibility decreases with age. The study concludes that the safe anatomical limit of urethral extensibility was applied to reconstructive surgery. This limit should be approximately 75% of the maximal constant traction length or a gap-to-normal urethra ratio of 1:4.

Five cases underwent tunneling of urethra through the glans after urethral mobilization. Among the five two cases had meatal stenosis. No meatal stenosis was noticed in cases those underwent glans wings procedure. So glans tunneling if not done properly by creating a wide glans tunnel may predispose to meatal stenosis. This finding coincides with the literature reviews (**H. Hamdy** and **M.A.Awadhi**). We used a wide glanular tunnel to transmit the mobilized urethra. The skin rim around the meatus was anastomosed to glans using 6/0 polypropylene sutures. If the end of the urethra was trimmed due to insufficient spongy tissue, we preferred not to tunnel it but to create triangular glans flaps. The mobilized urethral meatus was spatulated and anastomosed to the central triangular flap; the lateral glanular wings were wrapped around it. This technique creates a wide meatus and gives good coverage of the mobilized urethra. Presently the triangular flaps have replaced the tunneling procedure in all cases.

We kept 8 F infant feeding tubes as urethral catheter for a period of six days and on sixth postoperative day this catheter was removed and the child was discharged once he voids urine. There are different opinions regarding the

duration of catheter by different authors. Some kept the catheter overnight and then removed. Few studies advocate not using catheter (**Chang TS** and **Wishahi MM**). Some authors favored in keeping the catheter for 48 hours (**Caione P** and **Capozza N**). Since there was no anastomosis or flaps prolonged catheter placement is not warranted.

The overall hospital stay in this study is 6 to 13 days (average 6.6 days). There was a prolonged hospital stay in two cases (13 days) because of the complication they met and subsequent management. In some studies (**Caione P**) the hospitalization time was 5days (± 5days) and in some studies (**Wishahi MM**) it was 2 days.

Among the 25 cases those who are treated by urethral mobilization and advancement, in 21 (84%) cases the outcome was good. There was no meatal stenosis, no urethrocutaneous fistula and no meatal retraction. The urinary stream was straight and single. The meatus was seen at the tip of the glans and the parents and the children were satisfied with the appearance of the penis.

In this study of 25 cases we met 4 (16%) complications. One six years old child with glanular hypospadias had retraction of neomeatus and retention on sixth postoperative day following catheter removal. In another five years old child with distal penile hypospadias developed meatal retraction, scrotal edema and urethrocutaneous fistula on catheter removal. Two (8%) children one five years old and other seven years old with subcoronal hypospadias developed

meatal stenosis in the third month following urethral mobilization and advancement procedure. The first two complications occurred in the postoperative period itself. Another important finding was all the four complications occurred in the early part of our study. Probably the complications are due to our learning curve in the early part of this study. Inadequate urethral mobilization or thin spongy tissue at the distal end of the mobilized urethra may be the cause for meatal retraction and retention of urine and the cause for fistula and scrotal edema may be due to excessive dissection and unnoticed urethral injury. Among the five cases those who underwent glans tunneling procedure at the time of urethral mobilization two had meatal stenosis as a complication in the third month. Both the children with meatal stenosis were treated conservatively with dilatation and both of them improved following dilatations in two sessions. The child with retraction and fistula was treated initially with suprapubic cystostomy to relieve acute retention of urine and after three months definitive procedure in the form of double faced onlay flap urethroplasty was done. The child with meatal retraction and retention was treated with suprapubic cystostomy and a double faced onlay flap urethroplasty was done after six months. All the four children those who met complications were now doing well on followup. As per the literature there are other complications met by different authors which include penile haematoma, glanuloplasty disruption, stricture, dribbling, wound infection, secondary chordee and preputial edema. In our series none of the cases

had such complications. In some literatures the complication rate for fistula is 12% and retraction is 26% and in some study it is 2.1% and 6.4% respectively. In this study the overall complication rate was 16%, meatal stenosis 8%, fistula and retraction 4% and retraction 4%.

The followup period of this study was 6 months to 2 years. We had meatal stenosis as complication which occurred in two cases in the third month. Both the children with meatal stenosis were treated conservatively with dilatation and both of them were improved following dilatations in two sessions. No chordee was made out in any of the case in the followup period.

In this study the duration of surgery ranging from 45 minutes to 60 minutes and is dependent upon the length of urethra to be mobilized for advancement. In literature also the duration of surgery ranging from 30 to 60 minutes (**Awad Mohamed**).

This procedure is a good alternative for distal hypospadias. Although not a replacement for meatal- based flap procedures, and more tedious to perform than the meatal advancement and glanuloplasty procedure, this procedure has superior cosmetic and functional results and minimal morbidity. The advantages of this procedure includes, it does not need other tissues for covering the urethra, no anastomosis between the urethra and the neourethra, which can be a potential site for leakage and fistula formation and it can be applied to any type of distal hypospadias. This procedure can be very useful in circumcised individuals with

distal hypospadias where there is no tissue available for reconstruction. Further, the chordee (whatever its extent) has no influence on this procedure. A papery thin urethra is a contraindication to this procedure because of potential urethral injury during mobilization. ***Adequate corpus spongiosum is an essential prerequisite for successful urethral mobilization and advancemen***t.

Even though MAGPI procedure was simple and had little less complication rate, the overall complication rate was 3.8% (**Jawad AJ**) it is not generally applicable to all types of distal hypospadias.

This urethral mobilization and advancement procedure was also done for the management of selected cases of recurrent urethrocutaneous fistula (**Marzouk E**) by extensive urethral mobilization that advances the fistula opening to the neomeatus at the glans tip. Further this procedure was also applied to proximal hypospadias by combining this procedure with other technique like Duckett's transverse preputial flap, Thiersh-duplay urethroplasty and onlay island flap.

CONCLUSION

This study on urethral mobilization and advancement for distal hypospadias at the Institute of Child Health and Hospital for Children establishes the following things.

The average age of the children underwent this procedure was 3.6 years. The most common type of distal hypospadias was subcoronal variety and the most common associated finding in distal hypospadias was chordee. The average hospital stay in this study was 6.6 days.

The length of urethra need to be mobilized for urethral mobilization to cover the gap between the hypospadiac meatus and the glans tip should be in the ratio of 1:3.

The mobilized distal urethra should be brought to the glans tip by creating a glans wing. This creation of glans wing will prevent the occurrence of meatal stenosis latter.

Since there was no anastomosis between the urethra and neourethra, which can be a potential site for leakage and fistula formation and also this procedure does not need other tissues for covering the urethra the success rate is high in experienced hands.

The advantage of this procedure was its applicability to any type of distal hypospadias regardless of the severity of ventriflexion, normal appearance of the penis and good functional results.

The main indications are presence of glanular chordee, failed MAGPI, circumcised children with distal hypospadias, immobile fibrotic urethral meatus and as an alternative to MAGPI.

The complications occurred in this series are retraction, fistula and meatal stenosis.

PROFORMA

Name:	Age:	I.P.No:
Date of admission:	Date of Surgery:	Date of discharge:
Informant:		Reliability:

Position of meatus:

Presence of chordee:

Previous surgery:

Prepuce:

Complications:

Position of meatus after surgery:

Position of meatus at follow up:

BIBLIOGRAPHY

1. Ahmed Hadidi and Amir F.Azmy: Hypospadias Surgery an illustrated guide 2004;Springer-Verlag Berlin Heidelberg, New York.

2. Alan B. Retik, and Joseph G. Borer: Campell's Urology 2002;3:2284-27

3. Alexandro Da Silva E and Francisco J.B Sampaio: Urethral extensibility applied to reconstructive surgery 2002;167:2042-2045.

4. Anthony Atala et al: Urethral mobilization and advancement for mid shaft to distal hypospadias. The journal of urology 2002 ;168:1738-1741.

5. Awad Mohamed M.S: Urethral advancement technique for repair of distal penile hypospadias. Indian Journal of Plastic Surgery 2006;39:34-38.

6. Caione P and Capozza N: Distal hypospadias repair by urethral sliding advancement and Y-V glanuloplasty. J Urology 1991;146:644-646.

7. Chang TS: Anterior urethral advancement. A one-stage technique for hypospadias repair. British Journal Plastic Surgery 1984; 37:530.

8. De Sy WA, Hoebeke P: Trans-glandular urethral advancement for distal hypospadias-16-year experience. Ann Urol 1996;30:174-7.

9. Dindar H, Cakmak et al: Distal penile hypospadias repair in children, with complete mobilization of urethra and triangular glandular flap. Br J Urology 1995;75:94-5.

10. Haberlik A, Schmidt B, Uray E, Mayr J: Hypospadias repair using a modification of Beck's operation. J Urology 1997;157(6):2308-11.

11. Hamdy H and M.A.Awadhi: Urethral mobilization and meatal advancement: A surgical principle in hypospadias repair. Pediatric Surgery International 1999;15: 240-242.

12. Harrison DH, Grobbelaar AO: Urethral advancement and glanuloplasty a modification of MAGPI for distal hypospadias. Eur. Urol. 1990;17(1):40-2.

13. Jawad AJ: Urethral advancement and glanuloplasty vs. meatal advancement and glanuloplasty incorporated for distal hypospadias repair. Journal of Urology 1997;158: 1168-70.

14. Jay L. Grosfeld, James A.O'Neill, Jr., Arnold G. Coran, Eric W. Fonkalsrud and Anthony A. Caldamone: Pediatric Surgery 2006;2:1870-98.

15. Karamursel S and Celibioglu: Urethral advancement procedure for recurrent distal hypospadias fistula. Annals of Plastic Surgery 2006; 56:423-6.

16. Keramidas DC and Soutis ME: Urethral advancement and glanuloplasty in distal hypospadias. European journal of pediatric surgery 1995;5:348-51.

17. Marzouk E: Fistula management by urethral advancement procedure in the treatment of persistently recurrent urethrocutaneous fistula following distal penile hypospadias repair. Int. J Urology 1999;6(3):135-8.

18. Paolo Caione et al: Long term results of Distal Urethral Advancement Glanuloplasty for distal Hypospadias. J urology 1997;158: 1168-1171.

19. Roodsari SS, Mulaeian M and Hiradfar M: Urethral advancement and Glanuloplasty with V flap of the glans in the repair of anterior hypospadias. Asian J Surgery 2006;29(3):180-4.

20. Spencer JR and Perlmutter AD: Sleeve advancement in distal hypospadias Repair. J Urology 1990;144:523-5.

21. Uroz Tristan J, Garcia Urguelles X, et al: Analysis of 34 cases of distal hypospadias treated by modified Koff's technique. Cir Pediatr 1996; 9(2):78-80.

22. Wishahi MM and Wishahi MK: Study on Urethral advancement technique for repair of distal hypospadias. Europian Journal of Urology 1990;17:40-2.

Fig.2. Incision around the Meatus

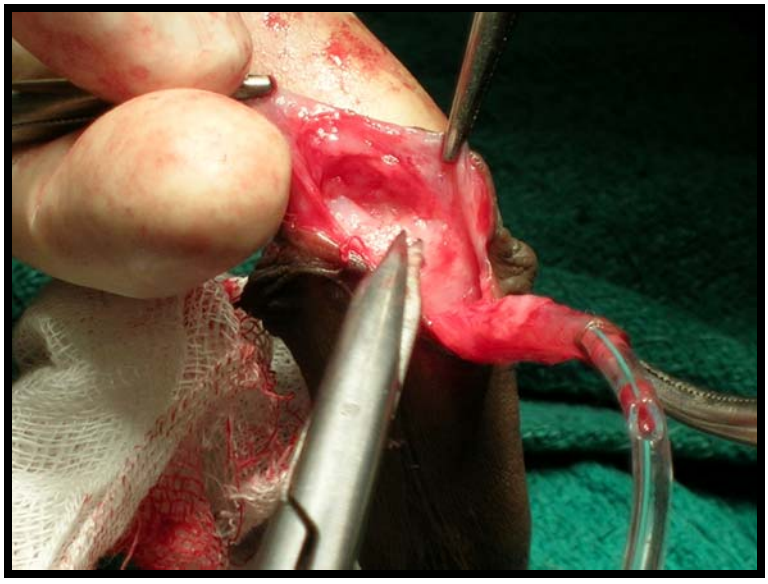


Fig.3. Urethral Mobilization

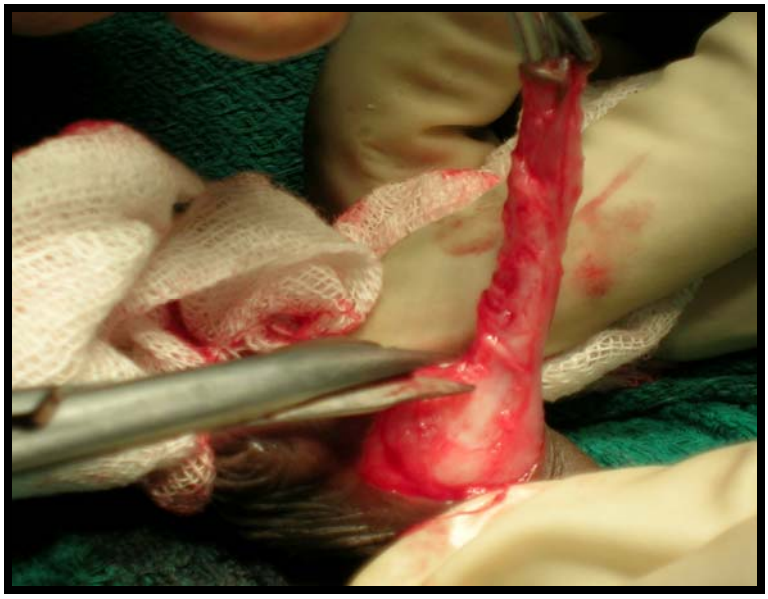


Fig.4. Further proximal mobilization

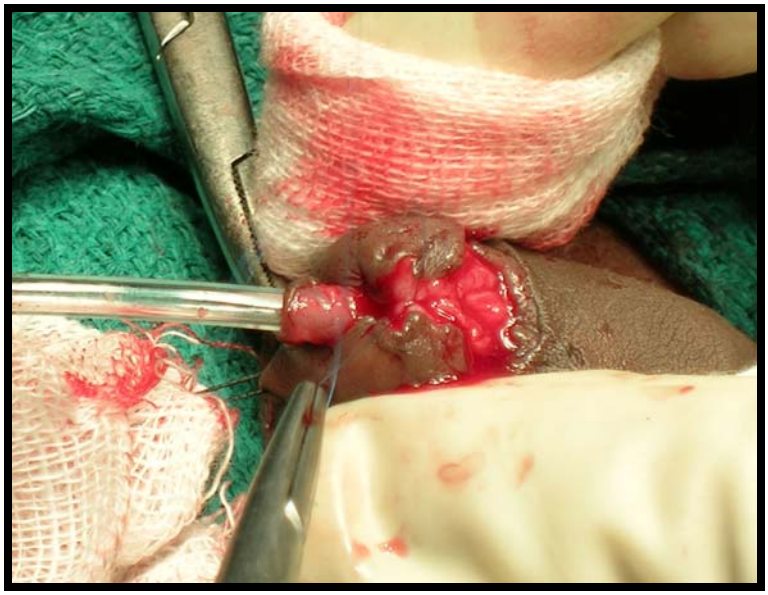


Fig.5. Glanuloplasty

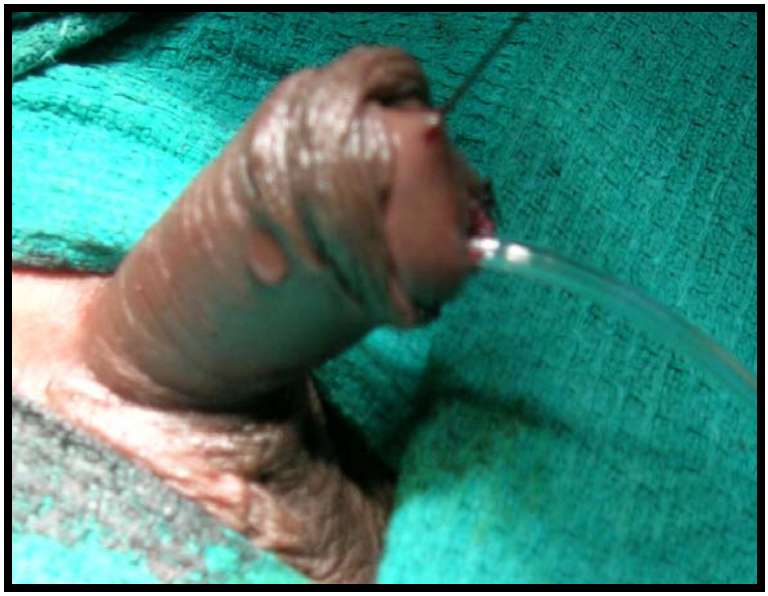


Fig.6. On completion

Fig.7. On follow up